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# SOIL EROSION

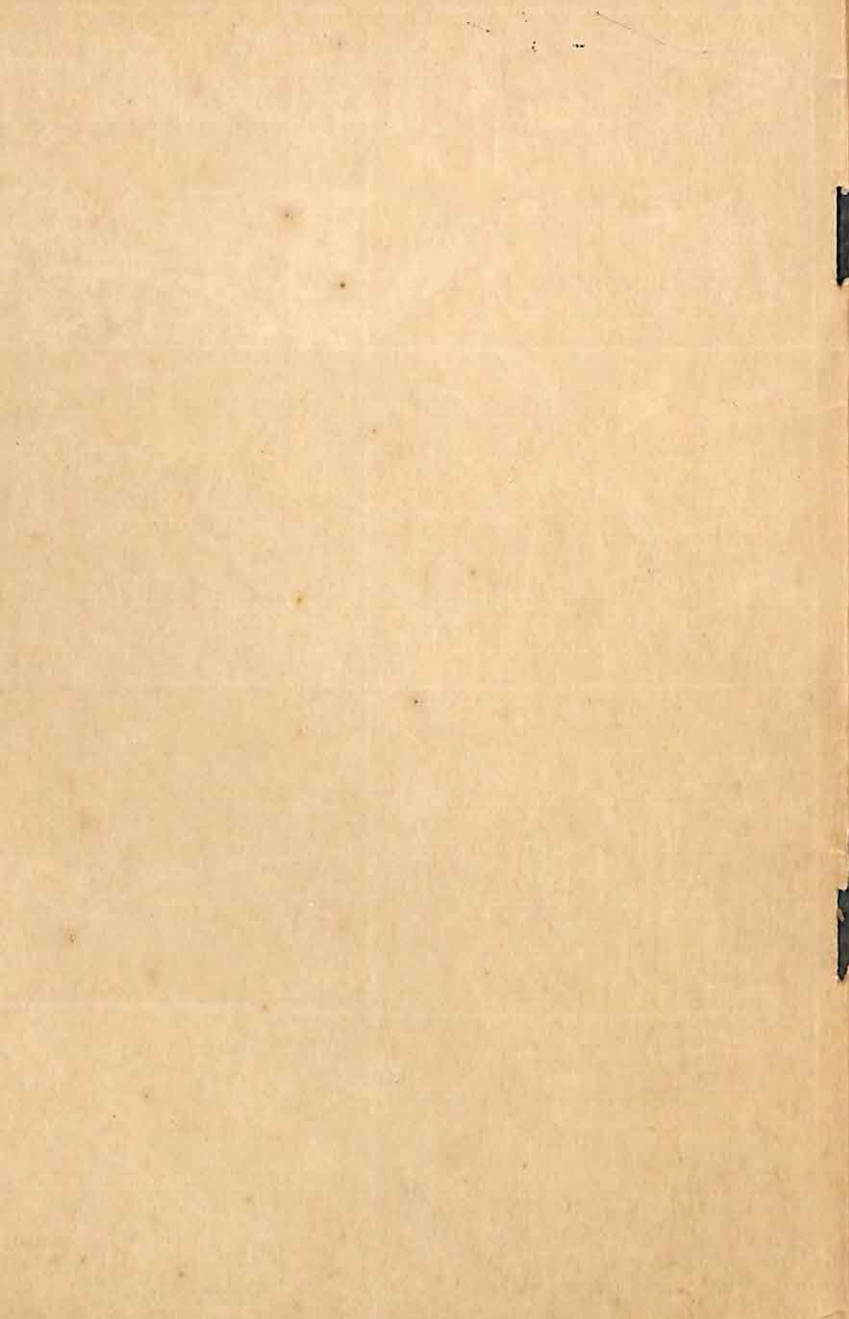
by

GWEN CROSS

FARMING SERIES

BOOK NINE

LONGMANS



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TROPICAL LIBRARY: FARMING SERIES

BOOK 9

# SOIL EROSION

BY

GWEN CROSS

*With illustrations*

*General Editor*

T. A. MCKAY, B.Sc.



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## CONTENTS

### PART 1. DANGER FROM WIND AND WATER

CHAPTER	PAGE
1. STORM AND FLOOD . . . . .	5
2. AS THIEVES IN THE NIGHT . . . . .	7
3. FARM LAND OR DESERT? . . . . .	9

### PART 2. THE CAUSES OF EROSION

4. THE CARRYING POWER OF WATER: SHEET AND RILL EROSION . . . . .	13
5. THE RUBBING POWER OF WATER: GULLY EROSION . . . . .	17
6. DAMAGE BY SHEET AND GULLY EROSION . . . . .	20
7. HOW WIND STEALS THE SOIL . . . . .	21
8. HOW MAN HELPS THE THIEVES . . . . .	24

### PART 3. CURING EROSION

9. THE BATTLE AT WONGO CREEK . . . . .	28
10. CURING WATER EROSION: (1) SHEET AND RILL EROSION . . . . .	30
11. CURING WATER EROSION: (2) GULLIES . . . . .	31
12. RECLAIMING WIND-ERODED LAND . . . . .	36
13. CURE IS ONLY A SECOND BEST . . . . .	39





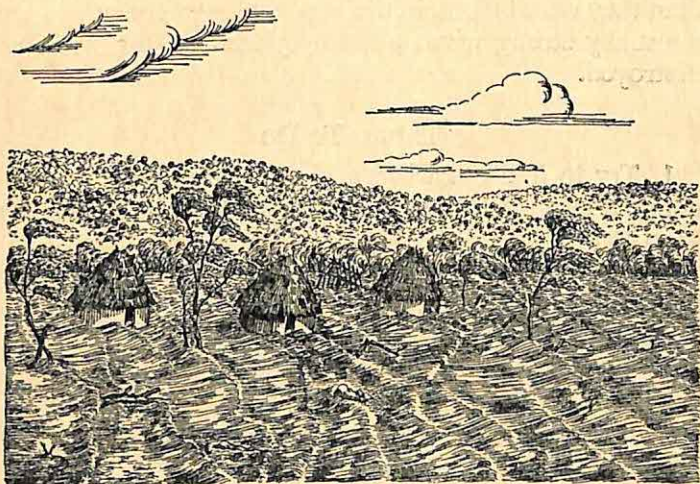
## PART. 1 DANGER FROM WIND AND WATER

### CHAPTER 1

#### STORM AND FLOOD

SOMETIMES we read in the newspapers or hear on the wireless that a great disaster<sup>1</sup> has happened. Perhaps an earthquake has destroyed a town, and many people have been killed or made homeless. Perhaps a long period of heavy rain has caused rivers to overflow their banks, and the floods have carried away houses, bridges, sheep, cattle, and people. Many have been drowned and many have lost their homes.

Perhaps a very strong wind has blown down trees, carried away the roofs of houses, and raised the sea in



Picture 1. Danger from flood

<sup>1</sup> Disaster: a great misfortune.

great waves, which have swept over the land. These waves can break thick concrete walls and bend thick, heavy pieces of iron as if they were twigs. The wind and the waves damage ships, aeroplanes, cars, railways, houses and farm land. If the strong wind blows over the desert, it carries the sand with it, so that men, animals and houses are buried.

Men can do nothing to prevent the earthquake, the heavy rain or the strong wind. They can only spread the news of the disaster, and ask for help for those who have suffered. Doctors and nurses go to look after those who have been hurt; engineers and builders go to look at the damage done to roads, bridges, and houses; others take food and clothing to the homeless. The Government helps to build again the houses, schools, shops, hospitals and factories. These, and the new sea-walls, are made stronger than they were before, in the hope that next time there are unusually strong winds and angry seas they will not be destroyed.

### THINGS TO DO

1. Try to find out when and where the last big earthquake happened or what damage was caused by the last great storm.
2. Find out in which countries great walls have been built to keep out the sea or to keep the rivers from overflowing.

### QUESTIONS

1. In what ways do people now get news of other places?
2. When there has been a disaster, how can people in other countries help?



## CHAPTER 2

### AS THIEVES IN THE NIGHT

WIND and water do other damage, about which we do not often hear. Men do not write about it much in the newspapers or say much about it on the wireless. People do not rush to put it right or send money to help to repair it. Not many know or care about it. Only a few fight against it and try to make it good.

This is the damage which wind and water are doing day by day, year by year, to the land in many places all over the world. Wind and water are stealing away the good soil that has taken thousands of years to make. They are taking the soil that man needs to grow the plants, which give him his food, his clothes, and things for his house.

We read in these books that the strong plants, which give us good food, can grow only on good soil. On poor soil the plants are small and weak; on very poor soil no plants will grow—the land is bare. Where a few years ago good crops grew, the land is bare. There are now big holes and cracks in the soil. The men who farmed there have gone to other places where there is good soil. Soon they will leave these places too, because the land has become poor.

Why does the land become poor like this? It is because wind and water have come like thieves and stolen the soil. But if they did not steal the soil before men went there, then the farmers themselves must have “opened the door” and let the thieves in. We would think a man very foolish

if he opened the door of his house to thieves, and let them steal his food, his clothes, and his money. Yet that is what many men are doing every day, for it is from the soil that farmers get their food, their clothes, and their money.

It is not only the farmer's food and clothes that are being stolen, but the food and clothes of other people. As the soil becomes poorer, less food is produced, and it is more difficult for people to get enough to eat. The time may come in some countries when people will starve because their fathers and their grandfathers did not look after their soil, but let the wind and water steal it from them. When the soil is taken like this, it is lost for ever, and it takes much time, work, and money to make the land fertile again.

### THINGS TO DO

1. Try to find out if the wind or water does any damage to land in your district.

Do you know any places where there were good crops a few years ago, but where the land is too poor to grow any now?

2. Is the soil on your land becoming better or poorer each year? Do you think the wind or water is stealing the soil? Watch any places where this may be happening.

### QUESTIONS

1. Write down the names of things you drink that are made from plants.

2. Write down the names of five things you eat that come from plants.

3. Name some plants and animals from which men get clothes.

4. What things in your house are made from plants?

## CHAPTER 3

### FARM LAND OR DESERT?

IN Book 1, Chapter 2, we read how wind and water, ice and snow, heat and cold break and rub the hard rocks on the earth's surface, slowly making them into soil. This goes on all the time, but so slowly and quietly that we do not see it happening. This kind of erosion began millions of years ago as soon as the earth cooled, and it gave us our good soil with the help of the plants that grew and died on it. These plants made a cover for the soil, protecting it from damage by the sun, the wind, and the rain, as well as making it richer with their dead stems and leaves. This kind of erosion is good, but we must not forget that it goes on very, very slowly.

The other kind of erosion is very bad. It steals away, often very quickly, the good soil, which the other kind has made so very slowly. It steals soil from the places which have lost the cover of plants that protected the land. When people speak of erosion they usually mean the bad kind.

When men take away the protecting cover of plants, plough the land, and then let it lie bare, the bad erosion begins. It steals away the soil and humus, and the land becomes poor. Then the men who have done this go away to seek new and better soil in other places. They have to clear land and build new houses, if they can still find land that does not belong to someone else. But there are not many countries now where new, free land can be found.



There are also other difficulties. Millions of men do not live in villages and work on their own farms to get food for themselves and their families. They live in big towns and have no land of their own to cultivate. They work for wages in factories, offices, schools, hospitals, and so on. With their wages they buy their food and clothes, and pay for their homes.

So the men on farms must grow more food than they need for themselves. They must grow food to sell to the people in the towns, which may be far away in other countries. To get all the food needed, farmers must cultivate much more land than they would require for their own families. If they allow the soil to become poor or to be lost, the harvests will be smaller, and there will not be enough food for everybody. When people do not get enough to eat, there is always much sickness and many die.



Picture 2. Danger from wind erosion

If hunger comes to a whole country, there is a disaster greater than any caused by stormy winds and floodwater.

In many parts of the world there are now deserts where once there were forests, grass-land, or farm land with towns and villages. The Sahara Desert many years ago was covered with forest, and 2,000 years ago there were towns and villages where now no one lives. When Abraham lived at Ur, he had great flocks of sheep and herds of camels. Ur now lies beneath the sand of the desert. It is not only in old times that fertile land has become desert. Less than thirty years ago a part of the United States of America, now called the "Dust Bowl", had good soil and produced good harvests. The farmers did not look after the land, but left it bare after they had harvested their crops. Then a wind came and blew the dry top-soil away. In parts of Australia the same thing has happened in the last thirty years. Places where large crops of wheat grew, or where many sheep grazed on good grass, will now grow only a few bits of poor grass, and all the people and animals have gone.

What has happened in other places can happen where we are. Will the fertile lands of Africa or Asia or the Pacific Islands become like the Sahara Desert or the Dust Bowl? Will our towns and villages be lost because we have neglected the soil and our grandchildren have had to move away or die of hunger? This will happen unless many more people learn about the soil and how to take care of it. In the rest of this book you will read about the causes of the erosion that steals away our soil, and what we can do to stop it.



## THINGS TO DO

1. Try to find out in what other parts of the world fertile land has changed to desert or poor grass-land. Try to find out the reasons for the change.

2. Are there any places near you where the soil has become so poor that the people have gone to new land? If there are, try to go and see both the new and the old farms. Try to find out why the soil of the old fields became poor. Could the farmers have done something to prevent this?

## QUESTIONS

1. What is the difference between the two kinds of erosion mentioned in this chapter?

2. How was the soil protected before men began to cultivate it?

3. Why do farmers now have to grow more food than they need for their own families?

4. Name one place where long ago the good land changed to desert and one place where it has done so in this century.

## PART 2. THE CAUSES OF EROSION

### CHAPTER 4

#### THE CARRYING POWER OF WATER : SHEET AND RILL EROSION

RAIN falling on the soil sinks into it or flows away over the surface; or it may do both of these things. If the soil is porous, soft and light, and if the rain is not falling too quickly, all the rainwater will sink in as it falls. If the land is level and the rain is falling very fast, some of the water will stay in puddles on the surface, or it may flow over the land until the rain has stopped. Rain flows away over the soil if the soil is not porous, is hard or heavy, or if the land slopes.

Water that flows away over the top of the soil is called the "top wash" or the "run-off". On a gentle slope the run-off flows away slowly, on a steeper slope it flows more quickly. If on the slope there is grass or if there are other plants growing close to each other, the rain will sink in more slowly and flow away more slowly than it does in places where there are few plants or none. The steeper the slope and the fewer the plants the more quickly the run-off flows away.

Flowing water has great strength. It can carry with it not only light things that float on the surface, but also heavy things which do not float. Water flowing swiftly downhill carries or pulls many stones along with it. The big stones are rolled along at the bottom of the water, and the smaller stones are pulled along over the top of them. At the bottom of the hill, where the water flows more slowly, the big stones are left and the smaller ones are carried on. As the water flows more slowly still over the

level land, the small stones also are left behind. Water flowing still more slowly carries pieces of soil and looks muddy. Only very slowly moving water does not carry soil with it, and looks clear.

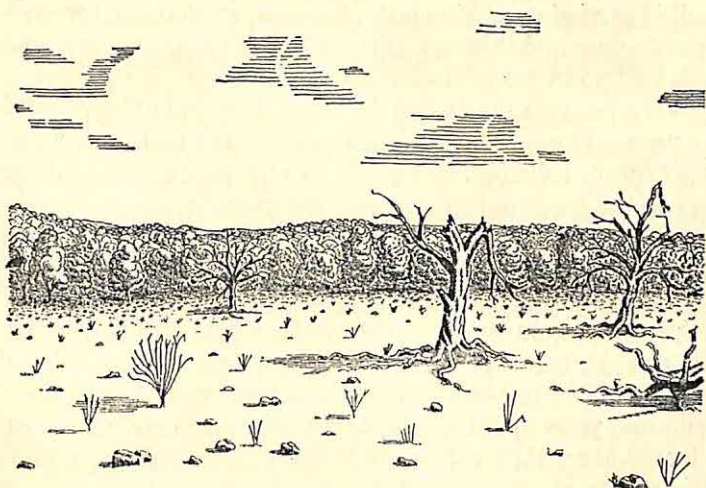
This carrying away of stones and soil usually means that they are taken from places where they are needed to places where there is no need of them. Running water carries the soil from the fields to the streams, the rivers, and the sea. When it rains heavily, rivers are often seen to be muddy; they are taking soil away from the land. The sea at the mouths of some rivers is often brown with soil that belongs to the land. The River Mississippi in the United States has built up a bank of soil 200 feet deep over a square mile of the ocean bed at its mouth. When some schoolgirls on a small Pacific island cleared a hillside, so much soil was washed down by the rains that in three months a well 12 feet wide and 20 feet deep was filled with the silt.<sup>1</sup>

Every time rainwater flows off land not well covered with plants it carries some soil with it. If the run-off is slow, the amount of soil taken each time may be so small that the loss is not noticed. Little by little the good soil, with its humus, is carried away until only poor soil is left. The farmer suddenly finds that the soil is bare and hard. If this happens on a large piece of land, much good soil is lost. It can happen if the grass or stubble on a large stretch of land has been burnt. The soil may go slowly, a little being taken every time it rains. Or it may be taken quickly from bare land that is washed by a heavy fall of rain. This kind of erosion, where the top-soil is washed away in layers from the land, is known as *sheet erosion*.

Very often sheet erosion is not noticed until it is too late

<sup>1</sup> Silt: soil carried away by water and dropped when the flow slows down.





Picture 3. Sheet-eroded land

to save the top-soil. Any of the following signs may tell us that it has begun:

1. The drainage water in furrows, ditches, and streams is brown.
2. The roots of the plants begin to appear above the soil.
3. The harvests are not as good as they were before; the soil is becoming poor.
4. Silt appears in the ditches or where a root or stone blocks a stream of water; ditches often need to be cleared of soil.
5. Bare patches of soil appear, often with a crust on them; water does not sink into the patches.
6. The sub-soil can be seen on hill slopes.

A rill is a small stream, and we borrowed the word from German, in which language it means a furrow. Rill erosion takes place in fields where the crops are planted in rows with furrows between them. Every time it rains, a little

soil is carried away down the furrows, so that the top-soil gets thinner and thinner. If it is allowed to go on, the good soil will all be taken, as in sheet erosion.

Very heavy rain falling in large drops may also start erosion. The heavy raindrops beat on the soil, and press the crumbs together. When the sun comes out, the surface of the soil hardens into a crust. When the next rain comes, the water does not soak into the soil. It runs off the top and starts sheet or rill erosion.

Sheet and rill erosion have taken place, and are still taking place, in many parts of the world. In the Black Belt of Alabama in the United States many square miles of top-soil have been lost by sheet erosion. More than a hundred years ago it was said that "the fields are no sooner cleared than they are washed away". In Australia now thousands of rills are taking the soil from the land and putting it into the rivers.

### THINGS TO DO

1. Half-fill a glass jar with water. Put in some small stones, some very small stones, and some brown soil. Watch them fall to the bottom of the jar as you put them in. Let the jar stand until the water is clear. Stir the contents of the jar quickly with a stick. The water becomes brown and the stones move round. Stop stirring, and watch to see what falls to the bottom first. How long after the stones stop moving does the soil begin to settle? You will see that, when the water is still, the soil will sink. How long does it take for all the soil to settle? What is the water like when the soil has all settled?

2. Walk round your land, and look for signs of sheet or rill erosion. If there are any signs, think what you can do about it.



## QUESTIONS

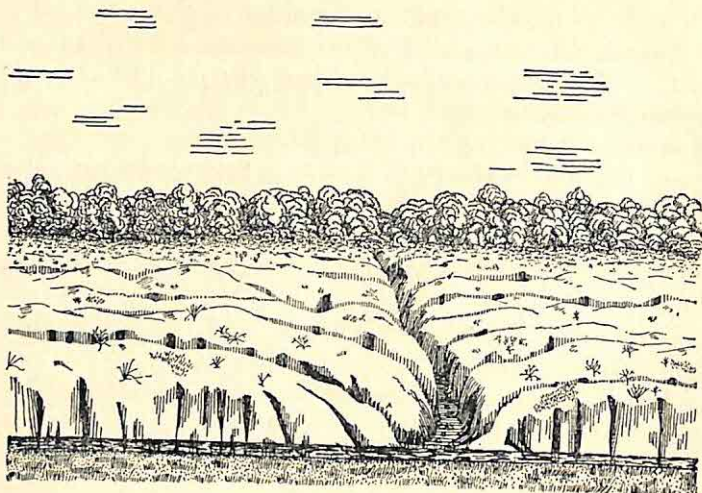
1. Under what conditions can you get "run-off" water on your land?
2. What is silt?
3. What would you do if, after rain, you saw brown water flowing in your ditches?
4. What would you suspect if you saw the roots of plants showing above the soil, or if patches of silt appeared on your land?
5. How does heavy rain sometimes start erosion?

## CHAPTER 5

THE RUBBING POWER OF WATER: GULLY  
EROSION

WATER always flows from a higher to a lower place. If the land is not flat, rainwater flows into furrows and holes in the soil. If the furrows slope downwards, the water flows in them, rubbing the soil from the sides and bottom. The furrows become deeper and wider. If two or more furrows meet, the greater amount of water flows more quickly and rubs away more soil. Stones and sticks carried along by the water scrape away still more soil. In this way the furrow grows bigger and bigger. It becomes both wider and deeper, and its sides may be straight up and down. When it is like this, and cuts deeply into the sub-soil, it is called a gully.

Gullies cause great damage to the land, and are signs of very bad erosion. Once a gully has begun, it is always becoming wider and deeper. Water falls into the gully



Picture 4. Gully-eroded land

over the top edge, which is rubbed away so quickly that the gully “eats back” into the land. The soil rubbed away by the water is carried down the gully and is lost. In a short time a small gully becomes a big one, and a big gully becomes bigger still. Water from five acres has been known to make a gully “eat back” 1,000 feet in a year, while the soil washed down it covered forty acres of good land and damaged it.

Gullies may begin as something very small—a cart-wheel makes a hole; a lorry or a plough makes a furrow; a farmer’s heavy boots or his tools pick up soil, leaving a small hole; people crossing a field make a little path where water collects and begins to flow. Any small furrow or hole, into and out of which water can flow, is enough to start a gully.

Water often flows into a gully at more than one place, and at each place the soil will be eaten back. In this way

branch gullies are made in the sides of the main gully. Gullies often develop from rill erosion. The rills make the furrows bigger, and where the water from several rills meets, a gully can soon start.

Besides damaging the land, gullies make the farmer's work much more difficult. As the gullies grow bigger, and carry away more and more soil, they cut back more and more into the land. They divide the field they are in into pieces of different shapes and sizes. It is difficult for the farmer to dig or plough the small pieces of good land that are left. And these pieces of good land become smaller all the time. The soil in the gullies is bad, for all the top-soil with its humus has been washed away. All that is left is leached soil, which has nothing in it to feed plants. Gullied land is therefore waste land.

### THINGS TO DO

1. Walk round your land or district, and look for gullies. Are they old, or are they just beginning? Have any of them got branches? Go and look at them when it is raining or just after it has stopped. Where is the water coming from? Is it carrying much soil? Is the soil being left anywhere near, or is it being carried to a river?

2. Put a stick in the ground a measured distance from the top of a gully. Go back after it has been raining and measure from the stick to the edge of the gully. Has the gully "eaten back" since you put the stick in? How many inches?

3. Find a gully that is just beginning. Mark it with sticks at the top and at the sides as in 2 above. Watch it becoming bigger each time it rains. Can you do anything to stop it getting bigger?



## QUESTIONS

1. Why is it difficult for a farmer to cultivate a field, in which there is gully erosion?
2. Why will crops not grow well in the gullies?
3. How do gullies damage the land both above them and below them?
4. Explain how gullies always grow bigger.
5. How do gullies develop from rill erosion?

## CHAPTER 6

## DAMAGE BY SHEET AND GULLY EROSION

IN New South Wales, in Australia, there is a place called Wongo Creek, fourteen miles from Manilla. Near this place runs the River Namoi, a branch of the big River Darling, which flows west and south from the New South Wales mountains to the Bight of Australia.

When farmers first came to this place, the soil was good and the crops gave good harvests. Slowly, without anyone seeing what was happening, the top-soil was lost by sheet-erosion. The crops did not grow so well, and the harvests became smaller. Small rills and gullies appeared, and soon became bigger. Every time it rained, the water ran quickly off the sheet-eroded land and down the gullies. It took tons of soil with it down the gullies and into the streams and rivers. The muddy water of these streams and rivers carried off for ever the farmers' precious soil.

The gullies became deeper and wider. Soon they were so deep that a man could stand in them without his head appearing above the edge. From being a few feet long they became a few yards long, then hundreds of yards long. Their branches cut through the fields like the veins of a

great leaf. Rabbits made their tunnels in the steep sides of the gullies, and so helped to break up the hard sub-soil. Each year the gullies became longer, deeper and wider, and the rabbits grew in numbers.

More and more soil was washed down the gullies, and the crops became poorer and smaller. The rabbits ate more and more of the crops the farmers planted. The farmers put up fences to keep out the rabbits. The rain-water flooded over the land and carried away the fences. The farmers could control neither the water nor the rabbits, and every year they became poorer and poorer.

Some of the farmers went away while they still had some money left. Others stayed on because they had not enough money to go away. Soon they were facing ruin—ruin of their fields by soil erosion and ruin of their health by worry and lack of food. In another year or two the land would be complete desert, and then what would they do?

Wongo Creek is not the only place in the world where this has happened. In many other places soil erosion has brought despair and ruin to farmers who could not, or would not, try to stop it before it was too late.

## CHAPTER 7

### HOW WIND STEALS THE SOIL

SOMETIMES, when we look over the garden we see that every branch and leaf is still. The air does not move, for there is no wind. Sometimes we see the leaves waving quietly to and fro, and we know that a gentle wind is blowing. At other times we see the leaves and branches moving quickly from side to side, and hear the noise they make as they rub against one another. We see leaves

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being torn from the branches and carried away through the air. From this we know that a strong wind is blowing.

We can see the leaves being blown away by the wind, but we cannot see the smaller things which the wind is also carrying away. When the soil becomes dry and bare, it cracks and breaks up into small lumps. These lumps break up into small separate pieces, which are very light. The wind blowing over the dry, bare soil lifts the small, light pieces of soil and carries them away. Pieces that are a little heavier are blown along the ground, rubbing against each other and breaking up into smaller pieces, which the wind can carry away. When these small pieces of soil are blown into our houses and fall on tables and chairs, we say that the wind is bringing in dust. But sometimes the wind carries this dust many miles over fields and mountains and sea.

A strong wind can lift pieces of soil too small for us to see, but big enough for us to feel when they are blown against our hands and faces. Where there is much dry, broken soil, as in a desert, the wind can lift so much of it that it looks like a cloud blowing over the land. We call this a sand or dust storm.

The lighter the soil and the stronger the wind, the greater will the damage be to the land. The wind is like an unseen thief stealing the fertile top-soil. Slowly or quickly it takes away the good soil; humus and plant foods are lost, so that the plants are weaker, harvests are smaller, and the farmer is poorer. Sheet erosion caused by the wind can make fields, that once yielded good harvests, into poor, bare, dusty land.

The wind damages more land than water does. It damages the land from which it takes the soil, and probably damages the land on which it sets the soil down. Good fields have been spoiled by dust that was once good top-soil in another place. In different parts of the world

to-day, farms, villages, and even great forests lie buried under tons of sand and dust.

In America, Australia, and South Africa, there are many square miles of land, from which the top-soil has been blown away because it was allowed to remain dry and bare. Cutting down trees may allow this kind of erosion to begin, because the wind can then sweep across the land, damaging and killing the smaller plants. The land is left bare, and sun and wind dry it up, so that it is soon like a desert.

Sheet erosion caused by water is often not noticed until much damage has been done to the land. It is the same with sheet erosion caused by wind. There are, however, signs which can show the farmer that it is happening. Little heaps of soft, light soil behind fences, tree trunks, and stones show that the wind is bringing soil from somewhere and leaving it in sheltered places. Bare patches appearing in grass fields or among crops show that the top-soil is being taken away. More dust in the houses, or dust storms blowing over, shows that erosion is taking place. Bare fields, a long spell of dry weather, and then a wind will often cause the farmer to lose many tons of soil from his best land.

### THINGS TO DO

1. Take a walk round your land or in the district where you live. Can you see any signs of wind erosion? From which direction does the wind usually blow to the places where the signs appear? Are there any trees to protect the soil from the wind? Is the soil light or heavy? How much of it has become bare? When did rain last fall? The answers to these questions should help you to find out why soil erosion has begun.

2. Find out if the land in any part of the country where you live has been badly damaged by wind erosion. If you

can do so, go and visit this place. If you cannot go there, try to get pictures showing the damage. Try to find out how long it is since the land began to lose fertility. What happened to give the wind a chance to begin eroding the soil?

### QUESTIONS

1. Name two signs of wind erosion.
2. What are the conditions which allow wind erosion to begin?
3. What can the farmer do to protect his land from wind erosion?
4. How does soil erosion damage land other than that from which the top-soil is carried away?

## CHAPTER 8

### HOW MAN HELPS THE THIEVES

WHEN the land is covered with trees, grass, and other plants, wind and water can do little damage to the soil. The plants protect the soil when they are alive; when they die they provide food for other plants to live on. Then how does it come about that erosion begins? Who cuts down the trees and clears away the grass and other plants? Who leaves the land bare of cover for the soil? It is man. Man prepares the way for wind and water to steal his soil. Man himself "opens the door" to the thieves.

#### *Man clears and burns the cover*

When men go to new places or new countries, they settle where they find good land. They need houses and food, so they go where there are trees growing. They cut down the trees and make their houses with the wood. They clear



the land by burning the stumps,<sup>1</sup> branches and leaves of the trees. They dig up the grass and other plants and burn them too. They till the soil and plant crops. They go on digging, planting, harvesting, and burning up what they do not want. They treat the soil as if it were a store of plant food that will never be finished.

Men dig the same piece of land many times, and keep planting the same crops on it. Between crops they leave the land bare. Humus and plant food are lost, and the structure<sup>2</sup> of the soil changes. Good soil has a structure like crumbs, and the particles which make it up have air spaces between them. (See Book 2, Chapter 5.) This structure is changed by much digging, loss of humus, and lack of plant cover. The soil becomes "dead", and hardens into big lumps. Instead of soaking into it, rainwater just runs off it. Such soil is ready for water erosion. If there is a long spell of dry weather, it will be ready for wind erosion.

People must have food, and farmers must till the soil to get it. But they must do it in such a way that the soil will be improved, and not allowed to be washed away by water or blown away by the wind. Good farming will preserve the good soil.

### *Man brings his animals*

Because they need meat and milk, butter and cheese, clothes, tents and blankets, men have kept animals for thousands of years. In the Bible we read of the flocks of Abraham and Lot, and that David and Amos were shepherds. The people of Central Asia and the Beduin people of the Arabian Desert live in tents and wander about from place to place with their animals. Farmers in many parts of the world keep cattle, sheep, goats, pigs, camels, rabbits,

<sup>1</sup> Stump: the lower end of a tree or plant after the main part is cut off.

<sup>2</sup> Structure: the way parts of a thing are put together.

according to their needs and the kind of country in which they live. When people go to a new country, they take animals with them.

In some countries men count their wealth in animals and not in money or in things which can be sold for much money. In some parts of Africa a man is considered rich if he has many cattle, even though they give him neither much meat nor much milk. In the Pacific Islands to have many pigs is to be wealthy. If only the number of animals is the measure of wealth, then some men will be tempted to keep more of them than their land can feed. Where this happens, as indeed it does in some parts of the world, the animals eat up the grass more quickly than it can grow. Each new leaf is eaten as soon as it appears, and the plants never grow big enough to have seeds. Without seeds there can be no new plants, so that the soil soon becomes bare.

When the grass is scarce, the animals have to walk about more to get their food. They damage some of the remaining grass by walking on it, and they break and stir up the soil where it is bare. The bare places grow in number and in size. The animals make paths from the fields to the drinking places, and these paths often go downhill to the water at the bottom. When it rains, water flows down these paths, and gullies begin. These gullies become deeper as the animals carry the wet soil away on their hoofs, or turn it into mud, which is washed away the next time it rains.

Animals like to rest in the shade of trees. There they wear away the grass and loosen the surface of the soil. Then a wind may come and blow the loose soil away. Goats eat the leaves of bushes and young trees, which in the end die because of the damage done to them. Pigs loosen the soil when they make holes in it by digging up plants with their noses. Rabbits both eat the plants and make tunnels through the soil.



So the animals which men keep may damage the soil, if care is not taken, and may open the way for soil erosion by both wind and water.

The land does not belong to the farmer alone, to do with as he likes. It belongs also to the farmer's tribe or nation, to his sons, and to his sons' sons. He should therefore farm it in such a way that, when he dies, he will hand on to his sons better land than he got. He will not do this if he thinks only of how quickly he can get rich. He must leave aside greed and selfishness,<sup>1</sup> and learn both how to keep his soil and how to keep it fertile. If he does this, and encourages his neighbours to do the same, he need have no fear of soil erosion.

### THINGS TO DO

1. Is any land being damaged in your district by unwise clearing and burning, by too much digging, by keeping too many animals? Why are these mistakes being made? Is it because of greed, selfishness, or lack of knowledge on the part of the farmers?

2. Find out what animals are kept in the following countries: Egypt, India, Melanesia, East Africa, England, Holland.

### QUESTIONS

1. What is good soil like in structure?
2. How does the structure of the soil change when the land is farmed badly?
2. In which country do rabbits damage the land very much?
3. In which country do people damage the land by keeping too many cattle?
4. What damage do goats do on the land?
5. In what ways can a greedy farmer harm his land?

<sup>1</sup> Selfishness: too great care for oneself.

## PART 3. CURING EROSION

### CHAPTER 9

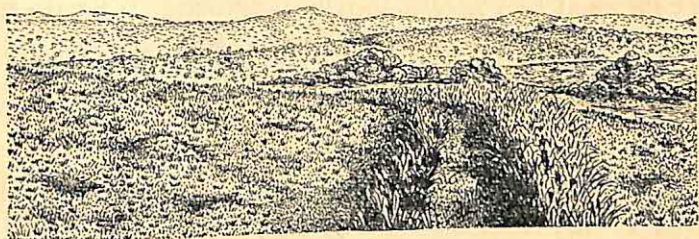
#### THE BATTLE AT WONGO CREEK

IN 1945 the Government of New South Wales, in Australia, began, through its Agricultural Officers, to help the farmers at Wongo Creek to fight the erosion that had almost ruined their land. (See Part 2, Chapter 6.) They first made war on the rabbits, of which they killed many. Then they brought machines, and made dams and banks across the places where the water flowed to the gullies. The water soaked into the banks of soil, and behind the dams it formed pools, where it became still and dropped the soil it had washed away from the top of the land.

With machines they began to fill the gullies with rocks and stones, which they then covered with soil. With other machines they broke up the hard, bare crust on top of the soil in the fields where erosion had been at work. This allowed the water to sink into the soil. To take the run-off water harmlessly away they made wide, gently sloping, shallow waterways, and planted them with grass. In these the water flowed quietly and slowly to the rivers.

Water no longer rushed over the land; the long, deep gullies had been filled in; the bare, hard surface on the land had been broken up. Damage by erosion had come to an end. True, the farmers could not put back the good soil they had lost, but they could stop more soil being carried away. They had now to make their soil fertile once more.

The farmers helped each other. They put up rabbit fences again. They listened to the advice of the Agricultural Officers and adopted new ways of farming. They



Picture 5. Waterway planted with grass

stopped burning the cover on the land. They made graded banks and ditches across the slopes of the fields, and they kept the ditches clean and in good repair. They put animal and plant manure on the soil to make humus, and they followed a good rotation of crops. They planted trees to protect the land from the wind, and they kept the soil covered with grasses, green manures and crops. Slowly the soil became better, the crops improved, and the harvests increased. Happiness and plenty returned to Wongo Creek.

The Agricultural Officers and the farmers at Wongo Creek have shown that erosion can be stopped and the damage it has done can be put right. What they have done others can do also. What is needed is the will to work hard and help each other, and readiness to accept advice and assistance from Government and its Agricultural Officers. Farmers, whose land has suffered from erosion, can make it fertile once again if they will only try hard enough.



## CHAPTER 10

### CURING WATER EROSION: (1) SHEET AND RILL EROSION

If the land is being damaged by sheet or rill erosion, we must first try to reduce the amount of run-off water. Then we must try to stop the run-off altogether. If we cannot do this completely, we must try to lead the water away so that it does not damage our own or other people's land.

We can reduce the amount of the run-off by breaking up the hard crust on top of the soil with rakes, hoes or machines. Under the crust there are holes and paths in the soil, through which the water can sink.

When we have reduced the run-off, we can try to stop it altogether by making banks of soil across the slope on the contour or grade lines. The soil in these banks absorbs or soaks up the water, so they are called *absorption banks*.

If the banks do not absorb all the run-off water, we must see that what is left is drained away without damaging the land. We can do this in one or more of the ways mentioned in these books:

1. by making gently-sloping ditches following the contour or grade lines;
2. by making grass-covered waterways leading to rivers, lakes or waste land;
3. by making dams to form silt pools and reservoirs, so that the water flows slowly and allows the silt to sink to the bottom.

#### THINGS TO DO

1. Fill two boxes or pots with soil, pressing it down hard so that it is tightly packed in them. Pour water on the soil and pour it off again, then let the soil dry. Do this several times until the top of the soil in both boxes is hard and crusted. Break up the top of the soil in one of the boxes

with an old fork, and pour a cupful of water on the soil in each of the boxes. Watch what happens to the water. In which of the boxes does it sink into the soil more quickly?

2. Make a shallow furrow about one yard long and 4 inches wide in the soil. Pour about a quart of water into the furrow just quickly enough for it to flow down the furrow before sinking into the ground. Now make a bank across the furrow midway between the ends. Again pour a quart of water slowly into the furrow. What happens to the water? Where does it go?

#### QUESTIONS

1. Why does breaking up the hard crust on top of the soil reduce the amount of run-off?
2. What is an absorption bank, and where would you make one?
3. How should a waterway be made?

### CHAPTER 11

#### CURING WATER EROSION: (2) GULLIES

It is very important to watch the land carefully, so that we can see where a ditch, furrow, rill, or hole in the soil is in danger of becoming a gully. As soon as we see that a gully is beginning, we must try to find out the reason. Then we must try to stop it growing bigger, and, lastly, we must repair the damage that has already been done.

##### *I—The Cause*

We must watch the gully for a time, and then try to answer questions such as these:

1. Is there always water in the gully? Is there water in it after a little rain, or only after a heavy fall of rain?

2. From where does the water flow? Does it come from higher land? from near-by? from farther away? Is it coming from ditches carrying drainage water, or is it the run-off from a field?

3. How did the gully begin? Did it begin as a ditch, a furrow, a rill, a footpath, an animal track, a grass field, or a field with a growing crop?

4. Are there any signs of sheet or rill erosion near-by?

5. Is the land round about bare, covered with grass, with crops, or with bush?

6. Is there a spring, lake or river near at hand?

7. Is the water in the gully underground drainage water flowing out at some place not far from the gully?

8. Where does the water flow to from the gully? Is it damaging your land or land belonging to another farmer?

9. Is the water clear or brown in colour? Are there any patches of silt below the gully?

10. Is the gully growing slowly or quickly? If you cannot decide this at once, stick a piece of wood in the ground near the top of the gully and see how quickly the gully eats back to the wood.

The answers to these questions will tell us what we need to know about the gully.

## II—*Stop the gully becoming bigger*

When we know how and why the gully began, we can try to stop the water flowing into it and making it bigger. It may be that there is a field which should be drained. Perhaps there is a ditch which should be made deeper, or which needs cleaning, or which is not in the right place. We may be able to stop the flow of water by making a pool above the top of the gully, or by making a grass waterway to lead the water to one side of the gully. We must stop the water flowing as soon as possible. If the problem of



how to do so is too difficult for us, we can ask the Agricultural Officer to help.

### III—*Repairing the gully*

What we do to repair the gully depends on whether or not we can stop the water flowing into it, and whether the gully is big or small.

#### A DRY GULLY

If the gully is narrow, or is just beginning to show itself, we can lay logs across it as if we were making a bridge over a stream. Then we should cut squares of grass and soil, and put them round the place where the water flows into the gully. If necessary we should put more of these squares on the ground at the other side of the logs. If the squares are pressed down firmly on to the soil, the roots of the grass will soon grow, and will hold both the grass and the logs in place.

If the gully is a shallow one, we might be able to fill it up with soil before laying the logs across it and putting down the squares of grass and soil. In any case we should always level off the ground where the gully begins.

If the gully is deep, much more work has to be done.

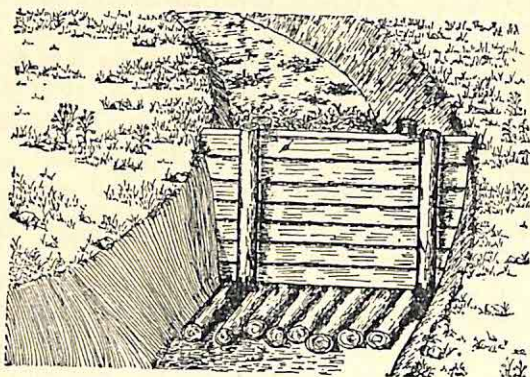
1. Across the gully make walls of logs, stones or brushwood.<sup>1</sup> You may have to drive strong posts into the ground to hold the walls.

2. When the walls have been made, put as many stones or as much brushwood as you can get into the bottom of the gully on the higher side of each wall.

3. Cut away the sides of the gully to make the steep slopes into gentle ones, and put the soil into the gully on top of the stones and brushwood.

4. Try to fill up the gully completely.

<sup>1</sup> Brushwood: branches of trees and bushes.



Picture 6. Log wall in a dry gully

5. Plant grass and other plants which grow quickly and have good roots to hold the soil together. (Ask your Agricultural Officer what are the best plants to use for this work in your district.)

6. Cover any bare soil with leaves and rubbish to protect it until the plants have time to grow.

### A "WET" GULLY

A "wet" gully is one which has water continually flowing through it, for it is not always possible to turn the water aside and make it flow by another way.

If we have to repair a gully of this kind, we should try to do it when the flow is at its smallest, that is when there is no rain. While we are repairing the gully, we should try by digging a ditch to make the water run elsewhere for the time being. Then after the repair work has been done, we can let the water flow into the gully once more.

1. First collect near the gully all the logs and stones that will be needed to make the walls. Pieces of galvanized iron, either straight or curved, can be used together with the logs.



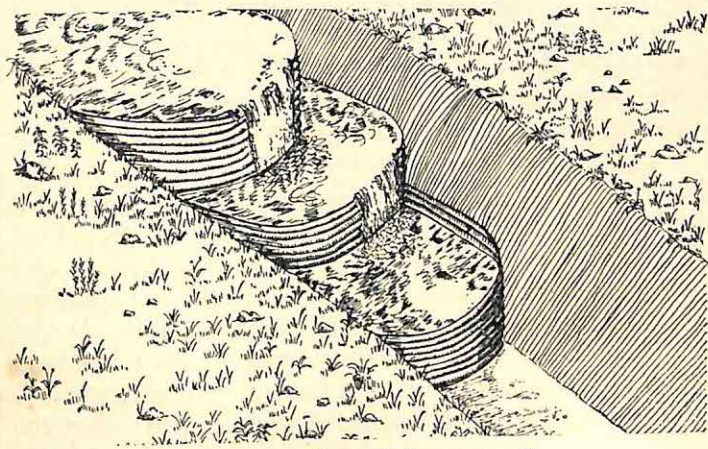
2. When all the materials have been collected, the work can begin. Beginning at the top of the gully, make strong dams across it to form silt pools. Water flowing down the gully will collect behind the dams, making pools in which the soil will sink to the bottom. When a pool fills up, the water flows over the dam into the silt pool next below it. These dams and pools keep the water from flowing quickly down the gully and making it bigger. They also prevent the soil from being carried away. The materials used in making the dams must be very strong and the dams must be firmly fixed to the sides and bottom of the gully.

3. When the dams have been made, use things such as logs, brushwood, wire netting, or even grass or straw to protect the bottoms of the pools.

4. Make the sides of the gully as even as possible and cover them with brushwood.

5. Grow grass and other plants on the sides and the top of the banks of the gully to hold the soil.

6. See that water flowing through the gully gets away without damaging the land below the gully.



Picture 7. Silt pools in a wet gully



## THINGS TO DO

1. Try to find a small gully on your own land or somewhere in the district. It is usually not difficult to find a new gully beginning. Using the list of questions given in this chapter, try to find out the cause of the gully. Try to stop the water flowing in the gully, and, finally, repair it.

2. Look for a place where there is a bad "wet" gully; you may have to look in the bush or on waste land for this. Try to find its cause, think out what you would use to repair it, where you would make the dams, and where you could safely lead the water away after it had flowed through the gully. If the gully is on your own land, you will want to do more than plan the work; you will want to carry it out as soon as possible.

## QUESTIONS

1. If you find a gully on your land, what three things should you do?

2. What is the best time to repair any gully?

3. How do you set about repairing a dry gully?

4. What difference does it make to the work if the gully is a "wet" one?

5. What is a silt pool, and what does it do?

## CHAPTER 12

## RECLAIMING WIND-ERODED LAND

DRY, bare soil soon becomes like powder. At first only a thin layer on top of the ground becomes like this, but, if there is no rain, more and more of the soil turns powdery. When the wind blows, the powdery soil forms ridges and furrows. As more and more soil turns into powder, the

ridges become hills and the furrows become valleys. These hills move with the wind, and are then called *dunes*. Sometimes a dune begins because the dry, powdery soil comes to rest beside a tree, a big stone, a fence, or a house. Soon more dry soil is added to the first small heap and the dune becomes bigger.

Dunes may even begin on good farm land because the wind has carried dry soil there from land that is being eroded. So wind erosion may damage the land of the good farmer as well as the land of the careless farmer.

In order to reclaim the land, the first thing to do is to try to hold the soil firmly in one place. We do this by growing on it plants which have good roots and which grow quickly. It also helps if we can cover the land with brushwood or dig in straw or rubbish. Some plants will not grow in sandy soil, and some of those which do hold the soil better than others. The Agricultural Officer will know which are the best plants to use in his district, and will help us to get them.

When the soil has been stabilized, or held firmly in place, by these plants, the next step is to begin growing food or other useful crops on it. One of the best crops to begin with is rye. Rye belongs to the grass family, and it has many strong roots. The grains are like wheat, but they are reddish purple in colour. Bread made from rye flour is dark in colour, and is called "black bread".

If the soil is very poor, superphosphate is put in to make the rye grow quickly and strongly. The seedlings grow best if the soil is made into ridges with shallow furrows between them. These ridges are made at right angles to the wind. If the ridges are made after rain, they will keep their shape better. The seeds are planted after the ridges have been made.

At this stage rye is not planted for the harvest it will

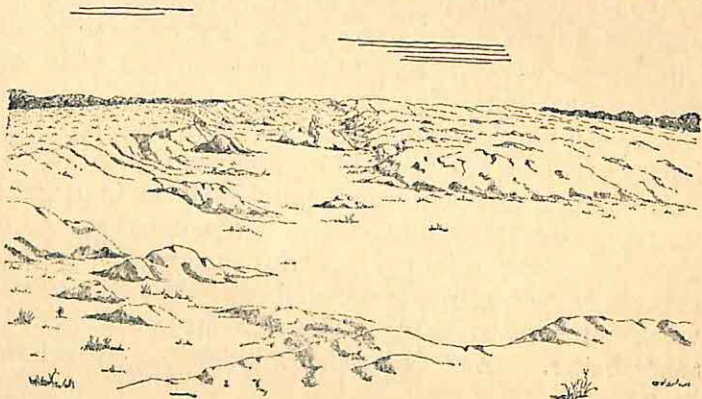
give. It is planted thickly in order to hold the soil together and to protect it from the wind. When the crop dies, it is cut down and left on the ground, to protect the soil until the next crop is planted. The dead plants rot and help to feed the soil. Rubbish on wind-eroded land should never be burned.

When the soil has improved enough, other crops are planted. So, by feeding the soil and keeping it carefully covered all the time, the land slowly improves and becomes good farm land once more.

The farmer must then take care that wind erosion is not allowed to begin again. He can give some protection to the land by planting a belt of trees on the windward side. But the best protection he can give is good farming.

### THINGS TO DO

1. If there are any sand dunes in your district, go and see them. If you cannot do that, try to get photographs of them.
2. Try to get some grains of rye. Plant them in a box



Picture 8a. Sand dune before reclamation





Picture 8b. The same sand dune levelled and sown with rye

and watch them grow. When the plants are big, take them carefully out of the soil. Wash the roots and have a good look at them.

3. If there is any wind-eroded land near you, try to turn it into good land again by following what you are told in this chapter.

#### QUESTIONS

1. What is a dune?
2. Why is it wrong to burn rubbish on wind-eroded land?
3. What plants does your Agricultural Officer say can be used to hold the soil on dunes?
4. What is the best protection against erosion?

#### CHAPTER 13

### CURE IS ONLY A SECOND BEST

CAN we people of to-day learn the lessons history has to teach us? Can we profit from the mistakes which our forefathers made?

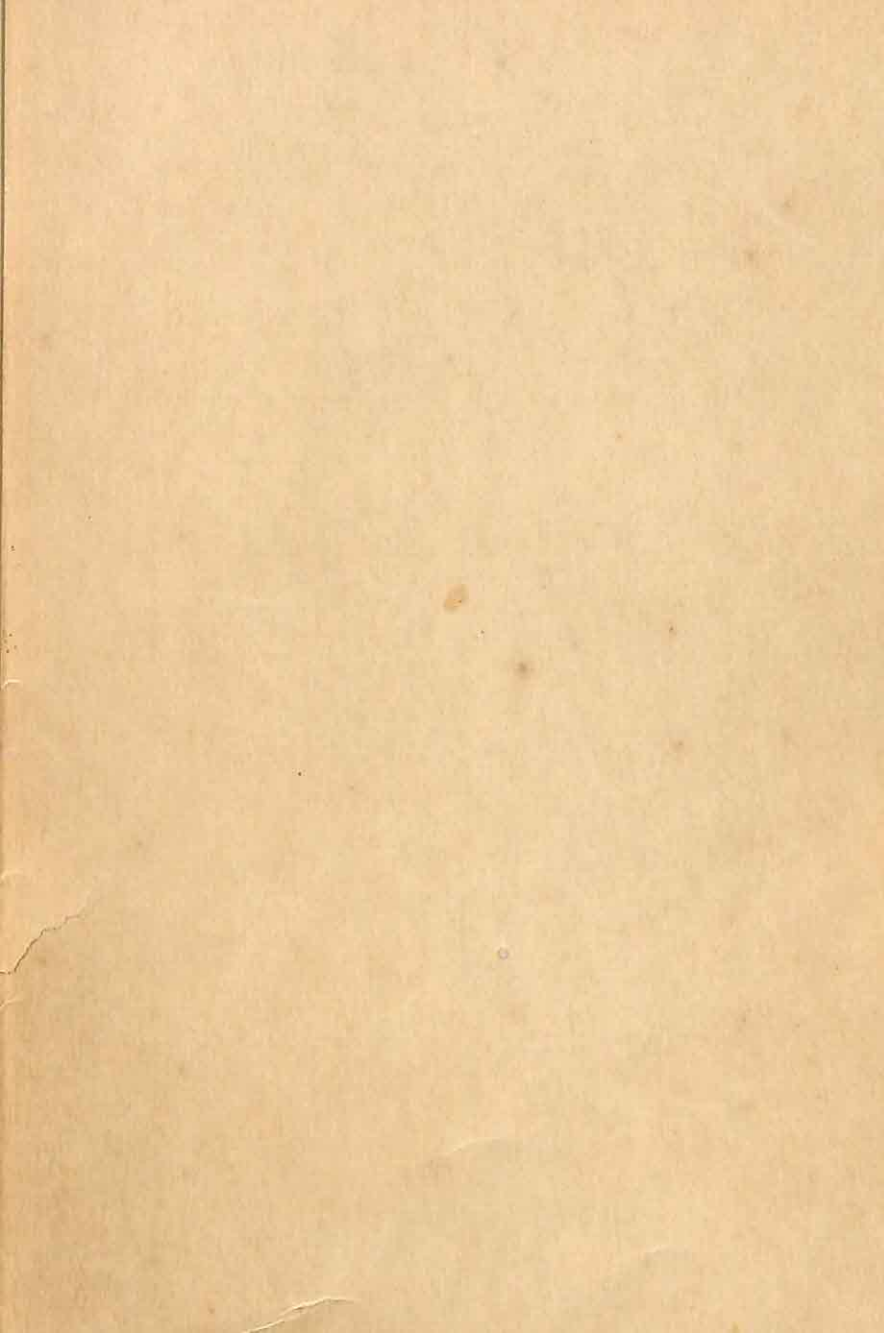
In North Africa, from the Atlantic to the Red Sea, there was at one time a great stretch of forest and park-land, where both men and animals could live. There were villages and fields, woods, rivers and lakes, where people like ourselves worked and played, tilled the soil and reaped the harvests, hunted and fished. Now all this is gone, and nothing is left over nearly the whole of these thousands of square miles but dry sand, bare rocks, and barren<sup>1</sup> mountains.

We do not know the full story of why the forest and parkland turned to desert, but we do know one of the reasons. Men failed to take care of the land. As late as two thousand years ago, irrigation canals and ditches carried water to places where now no one can live. These irrigation works either decayed or were destroyed, and the fertile soil dried up and blew away, or was covered by sand from already eroded fields.

In parts of the world to-day the precious soil is being washed down gullies to the rivers and the sea, or is being blown in dust clouds over the face of the land. People see this happening, but few try to stop it before it is too late. Yet we have what the ancient peoples of North Africa and the Middle East did not have—knowledge of the causes of erosion and of how to stop and cure it. We cannot expect to be forgiven by those who come after us if we leave them new deserts in place of fertile fields.

Yes, erosion can be cured. So can illness, but we think ourselves foolish if, though lack of care, we allow ourselves to become ill. "Prevention is better than cure" is as true of erosion as it is of disease. Cure is only a second best. Prevention is far better, and the way to prevent erosion is to conserve the soil. Soil conservation brings both present rewards and future blessings.

<sup>1</sup> Barren: not producing anything.





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